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GROWING  
CUCUMBERS  
FOR  
PICKLING



**C**UCUMBERS for pickling occupy approximately 75,000 acres each season in the United States, and the yield has a value of about \$3,000,000 annually to the growers. Successful growers often obtain a gross return of \$150 to \$200 an acre. This is a cash crop which is well worth attention in sections where it can be grown and handled.

Desirable conditions are fertile well-drained soil free from disease, a growing season of 120 to 150 days without extremes of heat or cold, and a moderate, well-distributed supply of moisture.

The handling of the crop requires salting stations within a reasonable distance of the growers, because the cucumbers must be gathered at frequent intervals, and it is not practicable to transport them long distances or to hold them for an extended period before brining.

For information as to growing table or slicing cucumbers in coldframes and as a field crop the reader is referred to Farmers' Bulletin 1563. Farmers' Bulletin 1320 treats of the production of cucumbers in greenhouses.

# GROWING CUCUMBERS FOR PICKLING

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## INTRODUCTION

AT LEAST 4,000,000 bushels of cucumbers are used for pickling in the United States each year. On the basis of first-grade sizes this would mean almost 3,000,000,000 pickles, a number large enough to prove the fondness of the public for a product low in food value but exceedingly popular as an appetizer and relish with other foods. In certain sections the production of cucumbers for pickling is an important industry bringing good returns to the growers. It is a cash crop that usually makes an appreciable addition to the farm income. Boys and girls often find a patch of cucumbers a most satisfactory means of making extra money for school or other purposes. This publication has as its purpose the description of cultural practices that are most successful in giving maximum yields.

### DISTRIBUTION OF COMMERCIAL CUCUMBER GROWING FOR PICKLING

The industry of growing cucumbers for pickling is distributed over a wide portion of the United States, especially the north-central area. Data collected and compiled by the Bureau of Agricultural Economics, United States Department of Agriculture, as to the acreage and value of cucumbers for pickling in the years 1925 to 1928, inclusive, are shown in Table 1. The average acreage for these years was 74,000. Michigan and Wisconsin usually produce about one-half of the pickling cucumber crop of the United States, but Indiana, Minnesota, Colorado, California, and other States also grow large quantities.

TABLE 1.—*Distribution, acreage, and value of cucumbers grown for pickling in the years 1925 to 1928, inclusive*

State	Acreage				Value			
	1925	1926	1927	1928	1925	1926	1927	1928
California.....	3,210	2,560	2,120	2,760	\$535,000	\$343,000	\$327,000	\$301,000
Colorado.....	3,500	2,900	3,130	2,300	357,000	154,000	117,000	145,000
Illinois.....	1,630	940	870	1,560	158,000	57,000	37,000	104,000
Indiana.....	8,430	7,250	7,470	9,870	477,000	439,000	264,000	549,000
Iowa.....	2,850	800	340	470	193,000	38,000	14,000	32,000
Michigan.....	36,810	25,030	20,360	22,840	2,248,000	1,030,000	550,000	1,156,000
Minnesota.....	4,340	3,000	1,770	3,210	201,000	122,000	39,000	85,000
Missouri.....	1,050	2,800	670	1,050	56,000	80,000	35,000	57,000
New York.....	1,320	920	680	800	152,000	28,000	44,000	39,000
Ohio.....	2,250	1,600	1,790	2,200	204,000	79,000	64,000	143,000
Washington.....	670	530	430	460	97,000	29,000	24,000	39,000
Wisconsin.....	20,960	11,950	8,500	10,190	1,252,000	550,000	367,000	456,000
Other States.....	13,110	10,360	9,930	9,570	1,043,000	566,000	648,000	386,000
Total.....	100,130	70,640	58,060	67,280	6,973,000	3,515,000	2,530,000	3,492,000

## FACTORS AFFECTING THE INDUSTRY

The cucumber-pickling industry has attained its greatest importance in sections having a combination of climatic and soil conditions especially suitable for the crop. Desirable conditions are a fertile soil, a relatively long growing season of 120 to 150 days

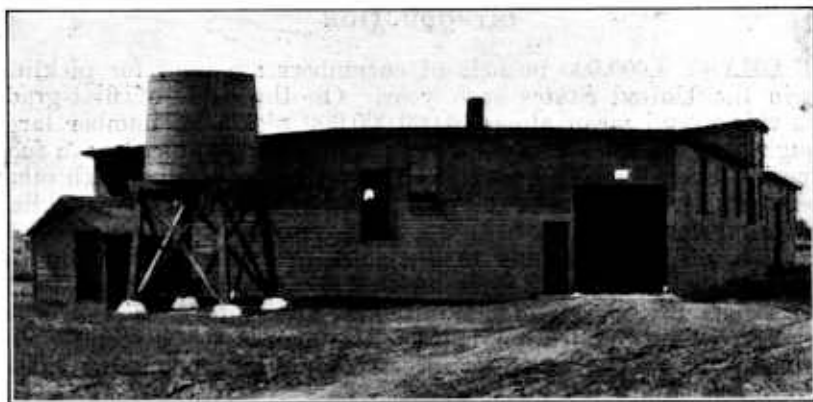


FIGURE 1.—Salting station for receiving and storing cucumber pickling stock

without extremes of heat or cold, and a moderate supply of moisture in the form of rainfall or by irrigation.

The handling of the crop requires that salting stations be available within a reasonable distance of the growers. These stations are almost invariably operated by pickle companies. A salting station is not especially expensive, usually consisting of a 1-story building (fig. 1) equipped with scales, screens, tanks, pumps, and other equipment needed for handling, salting, and storing the material. In localities where acreage can be contracted for, such stations can be provided without special difficulty. In some places brining tanks are mounted on flat cars, which are set on a siding while the cucumbers are being received, and are afterwards moved to the factory;

in others, small stations (fig. 2) are provided for receiving the cucumbers, and the material is then hauled by truck to salting stations or to the factory.

Although the commercial production of cucumbers for pickling is usually for this specific purpose, some attention has been given to the possibilities of the utilization of surplus market-crop cucumbers for pickling, especially in southern locations, where large quantities are grown for the early market. Some additional income often may be obtained by following this practice, but the bulk of the supply of cucumbers for pickles is grown entirely for that purpose. Summer temperatures in the lower South, and more especially the prevalence there of insect and disease enemies unfavorable to cucumbers during midsummer, have the effect of centralizing the cucumber-pickling industry in northerly locations at present.

The planting and the cultural care of the crop are not particularly difficult, but few growers undertake more than an acre or two each

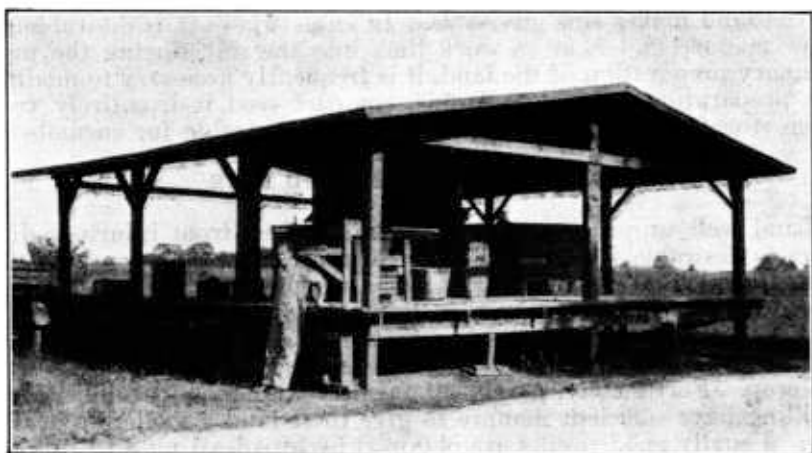


FIGURE 2.—Collecting station for cucumber pickling stock

season, because harvesting requires much handwork which must be performed frequently, sometimes daily, when growing conditions are favorable. Wide spacing of the plants is now generally practiced, as this greatly facilitates harvesting.

#### TYPE OF LAND NEEDED

None but the best land can be depended upon to give maximum yields of well-formed pickling cucumbers. The majority of growers believe that sandy loam, and even clay loam well supplied with organic matter and in good physical condition, are best adapted to the crop; nevertheless, cucumbers are successfully grown on many other types of soil, including peat, muck, clay, and even somewhat light sands. Soils of the lighter character, however, are especially likely to be affected by drought and are therefore undesirable. A soil with a rolling topography with good air drainage is preferable, because lowlands including muck and peat may be subject to frost damage.

Cucumbers should not be planted on land that has been recently used for melons, pumpkins, squashes, or cucumbers. It is recommended that cucumbers do not follow potatoes, sugar beets, cabbage, or other crops that make heavy demands on the fertility of the soil. A clover or alfalfa sod is recommended by growers as the best type of land for cucumber culture.

#### LAND PREPARATION

Preparation of the land for growing cucumbers for pickling is carried on in the same way as preparation for other farm crops. Thoroughness in all operations is of prime importance. Fall plowing may be desirable, especially on heavy land which will not wash or blow; moreover, lands of heavy texture plowed in the fall are mellowed by freezing and thawing. Plowing should be done either by tractor or by a heavy team plow capable of turning the entire furrow slice to depths of 6 to 8 inches, or even deeper if the character of the land makes this advisable. In cases where it is desirable to plow manure under, or to work lime into the soil, during the preliminary preparation of the land, it is frequently necessary to modify the preparation methods. A fine, compact seed bed, entirely free from stones, roots, or other obstructions, is desirable for cucumbers.

#### MANURE, FERTILIZER, AND LIME

Land well supplied with organic matter free from injurious diseases is desirable for cucumbers. However, an application of well-rotted manure is nearly always advantageous, and where available at moderate cost it continues to be the main dependence of many growers as a source of organic matter and plant food. Manure should be free from cucurbit remains, as these may carry diseases to the crop. Fortunately, nearly all farmers who grow cucumbers for pickling have sufficient manure to give their land a moderate dressing. Usually good results are obtained by broadcasting 8 to 10 tons to the acre about two weeks before planting time and thoroughly working it into the soil during preparation for the crop. Heavy applications are not advised, as a rule, provided the land has had good previous treatment.

Some successful growers supplement the manure application by a broadcast dressing of superphosphate, putting this on at the time the manure is applied. In most cases this practice is advisable.

Although many growers continue to depend entirely on manure, supplemental applications of high-grade fertilizer usually increase yields to a profitable extent. The specific fertilizer formula and the rate of application for each case must be determined by such factors as the natural fertility of the soil and its previous crop treatment. In general, a mixture containing 4 to 5 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 5 to 6 per cent potash, used at rates of 500 to 1,000 pounds per acre, is satisfactory. With applications of 500 pounds or less per acre the fertilizer can be applied in the row and mixed with the soil before seeding. Quantities in excess of 500 pounds per acre should be applied broadcast and harrowed in before planting. With land having a heavy clover or alfalfa sod it is per-

missible to decrease the percentage of nitrogen, and in some cases the potash. On such land a 2-10-4 formula at the same rates of application is generally sufficient. Commercial fertilizer alone should not be depended upon to produce good yields on soil deficient in organic matter. It is to be regarded as a supplement to organic matter and not as a substitute for it. The more general use of commercial fertilizer on pickling-crop cucumbers, especially on soils high in organic matter, without doubt would greatly increase yields and profits to both grower and buyer.

The cucumber is sensitive to acid soil; therefore an application of lime should be made to land which shows the need for corrective measures. There are a number of simple soil tests for acidity. Information in regard to such tests may be obtained from the various State experiment stations or from the United States Department of Agriculture.

#### VARIETIES AND SEED

Cucumbers are sometimes grown for the double purpose of marketing as fresh cucumbers and for pickling. The early portion of the crop is marketed fresh, and the later portions are sold for pickling. For this double purpose varieties having especially desirable marketing qualities are employed, but these are not especially satisfactory for the making of pickles. Moreover, plants that have grown full-sized cucumbers do not, as a rule, yield a high-grade product for pickling. Conditions sometimes justify the making of pickles to utilize a surplus crop that can not be profitably marketed as fresh cucumbers, but the bulk of the supply of cucumber pickles comes from crops planted and grown for that specific purpose.

A pickling variety of cucumber should be of the black-spine type and should combine early maturity with heavy production over a long season. The fruits should be of medium size, cylindrical shape, uniform dark-green color, and reasonably free from spines. Snow's Pickling, Chicago Pickling, Boston Pickling, and Jersey Pickling are four of the best-known varieties. The crop is usually grown under contract, and the pickle manufacturers usually reserve the right to specify the variety to be grown.

Good seed is of prime importance. From 1 to 1 $\frac{1}{4}$  pounds of seed is required to plant 1 acre. Some of the pickle companies supply their growers with seed, either free or at a nominal price. Seedsmen, particularly those in pickle-producing regions, pay special attention to supplying seed for the crop. It is quite possible for the individual grower to save his seed, but unless he has special facilities for saving and caring for the seed it may be better to purchase from those who are equipped to give the matter the special attention it demands.

Soaking the seed for five minutes in a 1 to 1,000 corrosive sublimate solution, washing in clear water, and drying is a wise precaution that helps in the control of certain diseases, particularly angular leaf spot.

#### PLANTING

Planting distances vary, but it has been found that wide spacing is advantageous. Rows are usually spaced 6 to 7 feet apart, with the



hills from 3 to 4 feet apart in the rows. Starr<sup>1</sup> makes the following comments on the subject:

If the plants are grown in hills, the field may be marked out in rows 4 feet apart one way and 6 feet apart the other. Sufficient seed should be planted in each hill to insure a full stand. After the plants are well established they should be thinned to two to the hill. In planting by hand with a hoe, care should be taken to place the seeds in moist soil, which should be lightly tamped with the hoe, after which a little loose soil should be drawn over the hill. This will check evaporation and prevent the formation of a crust. Not more than 1 inch of soil should cover the seed.

Later the same author says:

Many growers are now planting cucumbers in drills. If this method is practiced, it is necessary to mark the field one way only. The seeds are drilled in continuous rows, spaced 5 to 6 feet apart, and later the plants are thinned to stand 12 to 18 inches apart in the rows. This method tends to secure a more uniform distribution of the seed, involves less labor in planting,



FIGURE 3.—Thin planting, with one plant in each hill, a method of planting which makes picking easier

and facilitates harvesting operations. On the other hand, with the crop in hills it is possible to cultivate in both directions, thus saving somewhat in hand hoeing.

Many growers now make a practice of thinning to one plant in a hill; this branches profusely, often forming as many as 20 branches. Yields compare favorably with those from plants more closely spaced, and it is much easier to cultivate, spray or dust, and harvest the crop with these wide spacings. Figures 3 and 4 show a field with one plant in a hill. These photographs were made at the beginning of harvest and show how wide spacing and thinning to one plant in a place facilitates harvesting.

Figure 5 shows a field where close spacing and thick planting have been practiced, making the work of harvesting very difficult.

<sup>1</sup> STARR, G. E. CUCUMBER CULTURE. Mich. Agr. Expt. Sta. Circ. Bul. 90, 11 p. 1926.

Figure 6 shows conditions in a cucumber field where the plants are in drills. Cultivation can be carried on in but one direction, and the work of harvesting is increased. Wide spacing and thinning



FIGURE 4.—Cucumbers thinly spaced in wide rows, a method of planting that facilitates cultural operations and picking

make it possible to find all the fruits while of prime size for pickling, thereby insuring the highest financial returns. If the cucumbers are removed while they are small and while the seeds are soft,



FIGURE 5.—Cucumbers planted thickly and in closely spaced rows. It is difficult to cultivate and harvest cucumbers planted in this way

the quantity of high-grade cucumbers for pickling will be materially increased.

In northern Indiana and southern Michigan, where the cucumber-pickling industry has attained its greatest importance, planting

is done during May and early June. In any case it must be deferred until the ground is well warmed up and the likelihood of frost is past. Occasionally it happens that destructive frosts occur later in the season, but such cases are rare.

Soaking cucumber seed in water overnight will hasten sprouting. The soaked seed will come up in about three days, whereas unsoaked seed takes much longer, depending upon moisture, temperature, and other factors. Soaking is best accomplished by placing the seed in a muslin bag and immersing it in tepid water.

The first thinning should be made when the seedlings have from four to six leaves. Cutting the extra plants just above the soil surface, leaving the stronger and stockier ones, is recommended. When the plants have reached a length of 15 to 25 inches they should be



FIGURE 6.—Cucumbers closely spaced in drills, a method of planting that interferes with cultivation and harvesting

reduced in number to the desired stand. Plants having plenty of room frequently have 15 to 25 strong lateral branches and often yield more cucumbers than are obtained from plants more closely spaced.

#### CULTIVATION

The most important part of the cultivation of the cucumber crop consists in the careful preparation of the land. If it is well plowed and thoroughly fined to a depth of several inches the only subsequent cultivation necessary is that needed to control weeds. Since the cucumber is a shallow-rooted plant, cultivation not more than 2 inches in depth is best, because deeper stirring of the soil will injure the roots and hinder the growth of the plant. A 1-horse spike-tooth cultivator, with the teeth sloping back, is excellent. Two-horse cultivators may also be employed, particularly during the early part of the season when the vines are small, but as a rule the plants attain sufficient size by midseason to make such culture impracticable. However, if the vines are turned, horse work may be continued much longer, insuring better weed control at lessened

labor cost. Removal by hand of weeds and grass in the rows and close to the plants is necessary, but careful horse work will reduce the labor to a minimum. Cultivation or handling of the vines while wet should be avoided, as tillage tools, the hands, or clothing are likely to spread such diseases as mosaic, bacterial wilt, anthracnose, and cucumber scab from diseased to healthy plants.

#### TRIMMING VINES AND THINNING FRUITS

As a rule the vines of field cucumbers for pickling are not trimmed, since wide spacing gives each plant sufficient room to develop normally. Thinning of the fruits is never necessary. Harvesting small cucumbers from 2 to 3 inches in length has much the same effect as thinning the fruits, because it prevents them from reaching the stage where they would draw heavily on the energy of the plant.

#### PREVENTION OF DAMAGE FROM WIND AND COLD

The cucumber is especially sensitive to low temperatures. Damage from frost may be largely avoided by using land that has good natural air drainage and by deferring planting until two or three weeks after the average date of the last killing frost in the spring. In the commercial cucumber-pickle regions much attention is paid to the selection of land that is known as frost free. Lowlands that are fertile and otherwise suitable for cucumbers are usually avoided on account of their susceptibility to frost.

Cold winds are particularly injurious to cucumbers. Selection of a location protected by woodland or by artificial windbreaks will do much toward lessening all types of wind injury.

#### INSECT AND DISEASE CONTROL

##### INSECTS<sup>2</sup>

Cucumbers are attacked by a number of insects, two of which, the striped cucumber beetle and the melon aphid or louse, are widespread and are the cause of damage in most of the commercial producing territory.

##### THE STRIPED CUCUMBER BEETLE

The striped cucumber beetle appears in the late spring or early summer at about the time the earliest cucumber plants are coming through the ground. It may occur suddenly in large numbers, destroying the developing seedlings in a short time.

The control of the cucumber beetle is difficult, but there are several methods that have been used to advantage. In sections where climatic conditions are favorable, nicotine dust has given good results against this pest. A dust containing 3 per cent of nicotine is recommended, to be applied at a time when the foliage of the plant is dry and when the air temperature is above 70° F. This dust is prepared by mixing either a solution of free nicotine or nicotine

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<sup>2</sup> Prepared by W. H. White, Entomologist, Truck-Crop Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture.

sulphate with some carrier such as hydrated lime. The material can be obtained from commercial concerns, or it may be prepared by the grower. However, its preparation needs especial care, and unless the grower is properly equipped to make and store his own dust it is recommended that the commercial products be used, although they are more expensive than home-prepared mixtures. Instructions on the preparation of nicotine dust are given in Farmers' Bulletin 1499.<sup>3</sup>

Nicotine dust kills by contact. Therefore, in the process of treatment it is necessary to cover the beetles with the dust. Special types



FIGURE 7.—Device for dusting cucumbers during early stages of growth

of apparatus have been devised to prevent the escape of the beetles from the plants during treatments. One type of such apparatus consists of a funnel-shaped cone attached to the end of the discharge tube of the duster. An apparatus of this kind is shown in Figure 7. The box duster shown in Figure 8 is an inexpensive apparatus fairly well adapted for the application of nicotine dust. It is 8 to 10 inches square and about 12 inches deep, without top or bottom but with a suitable handle. Inside of this box and fastened to the upper edges is a porous bag of either cheesecloth or burlap from which the dust is sifted as the box is dropped over each hill or plant. The device is allowed to remain over each plant for a few seconds. The foregoing methods are adapted to the treating of plants in hills.

When the seed is drilled in

(fig. 6), the dust is best applied with the ordinary bellows or handle duster equipped with a type of nozzle that will direct the dust to all parts of the plant. Even in the case of large plantings, it will be found more economical to apply the dust by hand power, since in the use of power machines a large quantity of the material is wasted, especially if the crop is planted in hills.

In some sections good control of the striped cucumber beetle has been obtained by the use of a dust consisting of 1 part of calcium arsenate to 15 to 20 parts of gypsum or land plaster. In the use of this material it is necessary to keep the plants fairly well covered with the dust from the time that they appear aboveground until

<sup>3</sup> CHITTENDEN, F. H., and WHITE, W. H. THE MELON APHID AND ITS CONTROL. U. S. Dept. Agr. Farmers' Bul. 1499, 17 p., illus. 1926.

they have reached the runner stage, in order to protect the new growth. At this period in its growth the plant is usually able to withstand the attack of the beetle. Spraying with Bordeaux mixture and lead arsenate will also protect the plants.

The spotted cucumber beetle sometimes becomes a serious pest of the cucumber. It is more difficult of control than the striped cucumber beetle, but the measures recommended for the latter pest will give some relief.

#### THE MELON APHID

The melon aphid, commonly called the melon louse, feeds on the underside of the leaves, sucking the plant juices and causing the leaves to curl, lose color, and finally die. An especially serious phase of aphid injury is its part in transmitting mosaic and other diseases. Winged females start the infestation early in spring as small colonies which soon spread to adjoining plants. Early control measures are essential. Nicotine dust containing 2 to 3 per cent nicotine, applied to the underside of the leaves, gives effective control. In cases of mild infestation it is usually sufficient to dust affected and near-by plants, but if the pest is well distributed it may be advisable to dust the entire field. For dusting single plants a good hand duster with a nozzle that will shoot the dust upward so as to reach the underside of the leaves is satisfactory. For dusting the entire field a power machine may be used. Whatever device is employed, the dust must reach the underside of the leaves.

Spraying with nicotine sulphate is an effective control of the melon aphid. The solution is prepared by using three-eighths of a pint of 40 per cent nicotine sulphate, 2 to 4 pounds of laundry or preferably fish-oil soap, and 50 gallons of water. The object of the soap is to make the spray spread evenly, and the presence of globules on the leaves indicates the need for more soap. In using insecticides for the control of this insect it should be kept in mind that they must actually strike the insects. The application of spray to the tops of the leaves will not control or even seriously annoy this insect. Farmers' Bulletin 1499<sup>4</sup> gives further information.



FIGURE 8.—Box duster for applying nicotine dust to cucumbers

<sup>4</sup> See footnote 3.

DISEASES <sup>5</sup>

Cucumbers as a pickling crop are subject to a number of diseases, some of which may be avoided by planting on clean land and others reduced in severity by seed treatment, spraying, or other available control measures.

In the more northern sections, where the major portion of the pickling crop is grown, the most important diseases are bacterial wilt, mosaic, and anthracnose, with scab occurring in moist cool seasons. Angular leaf spot often causes considerable damage under favorable conditions.

In more southern locations downy mildew, root knot, and bacterial wilt are generally most common and severe.

Some of the diseases of cucumbers, muskmelons, and watermelons are caused by the same organisms, and for this reason cucumbers should not be planted in or adjacent to land where any of these crops were grown the previous year. A 2-year or 3-year rotation is even better to guard against a disease living over winter in the soil.

## BACTERIAL WILT

The bacterial wilt disease of cucumbers may reasonably be suspected when plants suddenly wilt and die without visible reason. This disease may attack seedlings a few inches tall as well as plants in midseason. It is caused by bacteria which enter and clog the water vessels of the stems and roots. Death of the plants generally follows soon. The causal bacteria do not live in the soil, but are carried over winter and spread in the field by insects, especially the striped cucumber beetle and the 12-spotted cucumber beetle.

The best method for the prevention of loss from this disease is closely related to the control of the beetles, which are primarily responsible for its spread. Spraying with 4-4-50 Bordeaux mixture and lead arsenate, or dusting with 1 part of calcium arsenate to 15 to 20 parts of gypsum, combined with the pulling and burying or burning of wilted plants early in the season, constitute the best control measures known. Nicotine dust has also been used with good results. Treatments should be begun as soon as the plants appear above the ground and should be repeated as often as necessary to keep the new growth protected.

## MOSAIC

The disease commonly called mosaic or "white pickle" belongs to the type of virus diseases. Its causal organism, if it has one, has not been found, but it is known to be carried in the sap of diseased plants and may be spread by insects, pickers, and field implements.

Mosaic occurs in many localities throughout the country and has frequently caused heavy losses to cucumber growers, especially in Michigan and Wisconsin. It is characterized by dwarfing of the plants, mottling, yellowing, and wrinkling of the leaves, and warting, curling, and mottling of the fruits. The disease does not live over winter in the soil, nor does seed from mosaic cucumber plants

<sup>5</sup> Prepared by W. W. Gilbert, Senior Pathologist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry.

often carry the disease. Its chief places of overwintering are in the seed of the wild cucumber, commonly grown as an ornamental vine, and in the roots of other host plants such as pokeweed, milkweed, groundcherry, and catnip. From these wild host plants, which come up ahead of cultivated crops, it is carried in the spring to cucumber fields by the striped cucumber beetle, aphids, or other insects.

The thorough eradication of the wild host plants in and near the fields, combined with the rigid control of insects, has in many cases proved very successful in controlling mosaic.

#### SCAB

The fungus disease known as scab is often very serious during moist cool seasons in certain northern cucumber-growing sections, especially in Michigan, Wisconsin, Minnesota, and Maine. On the leaves, stems, and fruits small water-soaked spots are produced, on which drops of a milky material are found early in the morning. The damage is most serious on the younger fruits in the form of small, sunken, rounded, or irregular cavities which frequently cause curling of the fruits. The disease spreads very rapidly in the field under cool moist conditions, and because of the great difficulty of sorting out diseased stock, deliveries are often refused from fields where the trouble has become well established.

Since the causal fungus lives over winter in the soil of fields where the disease has occurred, cucumbers should be planted on land not in that crop for one or more years. It is advisable to plant in locations with good air drainage and to avoid thick planting.

#### ROOT KNOT

Root knot is caused by tiny eelworms, or nematodes, which attack the roots of cucumbers and many other farm crops and produce galls or swellings. Affected plants are stunted or killed, and the yields are often much reduced. This trouble is frequently very serious in the sandy soils of the South, but is rarely of importance on pickling cucumbers in the North. Crop rotation and planting cucumbers only on land free from nematodes are the best methods now known of avoiding losses from root knot.

#### ANGULAR LEAF SPOT

Angular leaf spot, anthracnose, and downy mildew all cause their principal visible injury to the leaves, developing and spreading rapidly during moist warm weather.

Angular leaf spot, a bacterial disease, is characterized by small angular water-soaked spots on the leaves. In the later stages the spots dry out, become light tan to white in color, and sometimes drop out following heavy rains, giving the leaves a ragged appearance and causing considerable injury to the plant, especially when the attack comes early in the season. On the fruits very small round spots are sometimes seen which at first are water-soaked but later become whitish. The causal organism lives over winter in the soil and on the seed. Seed treatment for five minutes in a 1 to 1,000 mercuric-chloride solution followed by thorough washing in running



water is an effective remedy when combined with crop rotation to avoid infection from the soil. Thorough spraying with 4-4-50 Bordeaux mixture will also help to control the disease.

#### ANTHRACNOSE

Anthracnose, caused by a fungus, produces light-brown roundish spots, one-fourth to one-half inch in diameter, on the leaves, and elongated whitish sunken areas on the stems. The fruits in the crop as grown for pickling purposes are not commonly attacked by the fungus, but the loss to the crop comes from the reduction of the yield through premature killing of the vines. If hot, dry weather occurs, the disease may make little progress even though infection is present. The causal fungus is carried over winter on the seed and in the dead vines from a diseased crop. The best method of control is the same as that for angular leaf spot, viz, seed treatment, crop rotation, and spraying with Bordeaux mixture.

#### DOWNY MILDEW

Downy mildew, also caused by a fungus, is recognized by a faint yellow angular spotting of the leaves, which soon curl, dry up, and die. The fruits are not directly affected, but the yield is so reduced by the killing of the affected plants that losses are often considerable under favorable weather conditions. Mildew is most common and severe along the Atlantic seaboard and in the Gulf States. In the Central States its occurrence is less certain, it comes later in the season, and it causes less damage. Thorough spraying of the cucumber vines with 4-4-50 Bordeaux mixture is the best available method of control for mildew and will materially check its development if begun when the first signs of disease appear and repeated at intervals of 7 to 10 days to keep the new growth protected.

#### SPRAYING AND DUSTING TO CONTROL LEAF DISEASES

Spraying with Bordeaux mixture is a preventive rather than a cure for fungous and bacterial leaf diseases. For the most successful results the work must be started early in the season (before the diseases become established) and must be done thoroughly with high pressure, so that all parts of the plants are kept coated with the spray mixture. It is also important that the Bordeaux mixture be properly made and applied at intervals sufficiently frequent to cover the new growth promptly.

For most cases the 4-4-50 Bordeaux mixture (4 pounds copper sulphate, 4 pounds stone lime, to 50 gallons of water) is recommended, but sometimes a weaker solution (2-4-50) is advised, especially in sections where vine injury has resulted from the stronger mixture.

The spraying of pickling cucumbers has in many sections come to be looked on as a second line of defense in fighting leaf diseases, to be used only in case the seed treatment and crop-rotation methods have not been successful in preventing or sufficiently delaying the outbreak of disease.

Dusting with copper-lime fungicidal dusts has been tested to a considerable extent; in some instances the results were equal or nearly equal to those obtained with spraying. Its principal advantage is its quicker and easier application and the fact that the handling of large quantities of water is eliminated. Its main drawbacks are the greater cost of material and, in some instances, reduced effectiveness in disease control. Each grower must determine for his particular conditions whether spraying or dusting will be most advantageous and economical when such means of disease control is needed.

#### HARVESTING AND HANDLING

The rate of growth of the cucumber depends upon soil fertility, temperature, moisture supply, and the degree of protection afforded from injury by insects and diseases. Under favorable conditions cucumbers should begin blooming in a month to six weeks from the time the seed is planted and should produce fruit of pickling size in about eight weeks from seeding. At first the blooms are nearly all male or staminate, but later on the female or pistillate flowers ap-

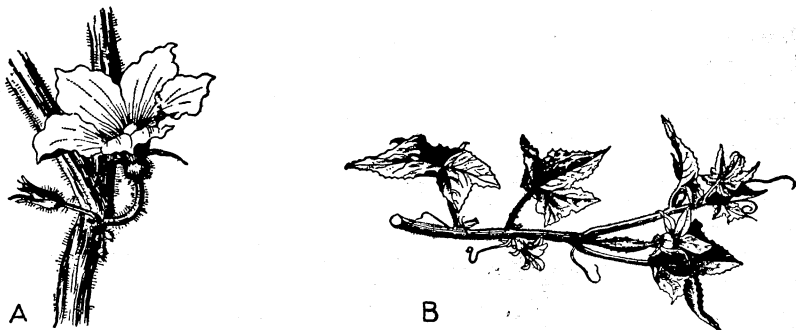


FIGURE 9.—Flowers of the cucumber: A, Male or staminate; B, female or pistillate flower

pear in abundance. These are easily distinguished by the small cucumber between the flower and the stem. Figure 9 shows these differences. During the first two or three weeks after harvesting begins comparatively few fruits are borne, but it is very desirable that these be removed at frequent intervals while small. The fewer the cucumbers allowed to become full grown, the more the vines will bear. The frequency with which pickling cucumbers must be harvested depends somewhat upon weather conditions, but it is often necessary to pick every day. Small cucumbers, those from 1 to 3 inches in length, are worth about three times as much per pound as large ones, and it is to the advantage of the grower to gather his cucumbers often enough to have the greatest possible proportion within the first grade. Furthermore, frequent harvesting is extremely desirable, because it prevents the development of large fruits, which deplete the vitality of the plant.

Planting in hills and wide spacing are distinct helps in harvesting cucumbers for pickling. (Figs. 3 and 4.) Under such conditions it is easy to find all the fruits before they become too large.

Picking cucumbers at the stage for pickling is a rather slow and laborious task, this phase of the work being responsible for the fact that cucumbers for this purpose are usually grown in small areas, because it is difficult to obtain help to harvest large fields. Emphasis is placed upon the desirability of wide spacing and thinning to single plants as aids in harvesting, because the pickers can easily examine all parts of the plants. When the cucumbers are planted close, as shown in Figure 5, all cultural operations are difficult, and it is practically impossible to find a large part of the fruits before they become too large. The daily picking from the acre or two in the average-sized cucumber patch can be easily transported to the collecting or the salting station in a buggy or a light automobile and presents no difficulties.

Practically all cucumbers for pickling are grown under contract between a pickle company and the farmer. The buyer specifies the grades into which the cucumbers shall be divided and the price paid for each grade. The best pickling cucumbers are from 1 to  $3\frac{1}{2}$  inches in length, straight, cylindrical in shape, and count not less than 850 to each 50 pounds. This grade commands about three times the price paid for larger or inferior stock. A large demand exists for large sour and dill pickles. Cucumbers from  $3\frac{1}{2}$  to  $5\frac{1}{2}$  inches are used for these. Most pickle manufacturers specify that the stock as delivered must not contain more than 40 per cent of these oversized cucumbers. Another grade consists of small crooked specimens, or nubbins. These are used for the making of chop pickles, and as such they bring a lower price than the No. 1 stock. It is to the interest of the grower to grow cucumbers of high quality, with a minimum percentage of the undesirable grades.

In some cases, especially where there is insufficient acreage in a locality to justify the erection of a salting station, the cucumbers are graded in the field by a representative of the buyer, who sends them to the salting station by truck. In other cases the pickle company maintains a collecting station (fig. 2) where the stock is received and paid for and afterwards hauled to the salting station (fig. 1), where the cucumbers are brined and held until needed. As salt-stock pickles can be kept for more than one season, it is possible to bridge over seasons of low and high production without violent fluctuations in the prices paid to producers. Most pickle companies encourage their growers in every possible way, as they are anxious to maintain production in localities where they have established salting stations.

#### YIELDS AND RETURNS

The average yield of pickling-crop cucumbers in the United States over a period of several years is about 50 bushels per acre; however, good growers frequently obtain from 100 to 150 bushels per acre.

Prices paid for the stock vary widely, depending upon the locality and the grade of the cucumbers; but \$1 to \$3.50 per hundred pounds, the price depending on the grade, represents the prevailing practice. On this basis it is apparent that a successful grower may obtain a gross return of \$150 to \$200 per acre.

The main item of money outlay in growing cucumbers is for fertilizer, unless extra labor is hired for harvesting; but this work is usually done by the members of the family.

Cucumbers for pickling are a cash crop and especially attractive to persons who wish to supplement their regular farm income. The young man shown in Figure 3 made \$150 during 1927 on the 1½-acre cucumber patch shown in the illustration. Figure 4 shows a 2½-acre patch grown on rented land by a school teacher who occupied a part of his vacation in this manner. Success in the work depends on a location having the right soil and climatic conditions and upon its nearness to a salting station.

# **ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE**

March 21, 1930

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